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SCHLUMBERGER OILFIELD SERVICES
200 GILLINGHAM LANE
MD 200-9
SUGAR LAND, TX 77478

EXAMINER	
HUGHES, SCOTT A	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/604,878	Applicant(s) ESMERSOY ET AL.	
	Examiner SCOTT A. HUGHES	Art Unit 3663	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE _3_ MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on _29 May 2008_.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) _18-35_ is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) _18-35_ is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on _22 August 2003_ is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _5/29/2008_.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

Applicant's arguments filed 4/10/2008 have been fully considered but they are not persuasive.

Applicant argues that Kan does not show making travel time determination when the drill bit is at a selected depth. Kan teaches making travel time determinations with a receiver in a borehole during a VSP survey, but does not disclose that the drill bit is at a certain depth when this is done. This was acknowledged in the prior Office Action, and Kan was modified by the teachings in Eaton that the receiver can be in a device located near the drill bit for performing VSP surveys. This has the benefit of not needing to take the time to remove the drill string to take measurements.

Applicant argues that Eaton does not disclose any devices for recording and processing signals from the receiver. Applicant argues that Eaton relies on direct communication of the detected seismic signals to the surface. This argument is not persuasive because Eaton specifically mentions (as seen in applicant's underlined portion of Eaton's disclosure) that a processor near the drill bit can be used, and that processed data is transmitted to the surface. Eaton specifically teaches that the processing means can be at the surface or in the borehole (near the drill bit). Eaton discloses that processing means near the drill bit can process VSP data, and that these processing means are in signal communication with the receiver (they receive signals from the receiver to process, and therefore must be in signal communication with the receiver) (See Eaton, Column 6). Eaton discloses that the processing, which can be

done by the processing means in the borehole, includes determining travel times and determining arrivals of direct (downgoing) and reflected (upgoing) waves. Therefore Eaton does not rely on direct communication of the detected signals to the surface for processing. Although the eventual processed signals may be sent to the surface (Column 6, Lines 30-35 of Eaton), one type of processor disclosed by Eaton is located in the borehole and therefore Eaton meets applicant's claim limitation of a processor disposed in the borehole.

Kan also specifically teaches that the processing of the detected signals in VSP includes detection of arrivals of upgoing and downgoing seismic energy from a seismic source on the surface.

Further, Kan discloses that determining travel time includes operating a receiver in a borehole at selected times (selected times during drilling) corresponding to predetermined actuation times of a seismic source at the surface of the region (Kan discloses that the source and receiver are operated together, and therefore the receiver is operated at the selected times of firing the source), detecting seismic energy from the seismic source, and operating a processor in signal communication with the receiver to detect arrivals of upgoing and downgoing seismic energy from the seismic source (Column 7, Line 65 to Column 9, Line 47).

Applicant's claims are therefore obvious in view of the combination teachings of the processing of data in Kan and the teachings of Eaton of operating the receiver when the drill bit is at a selected depth and using a processor disposed in the borehole so that processed data is sent to the surface.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 18-35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kan in view of Eaton (6382332) and Leaney.

With regard to claim 18, Kan discloses a method of estimating velocity ahead of a drill bit disposed in a subsurface region (Column 8, Line 40 to Column 9, Line 10). Kan discloses obtaining surface seismic data for a region of interest, but does not disclose that this data is used in the inversion (Column 8, Lines 40-57). Kan discloses during drilling of a borehole traversing the subsurface region, determining a travel time of a seismic wave generated from a surface of the region to a location in the borehole when the drill bit is at selected depths in the borehole (Column 7, Line 66 to Column 8, Line 57). Kan discloses determining travel time including operating a receiver in a borehole at selected times (selected times during drilling) corresponding to predetermined actuation times of a seismic source at the surface of the region (Kan discloses that the source and receiver are operated together, and therefore the receiver is operated at the selected times of firing the source), detecting seismic energy from the seismic source, and operating a processor in signal communication with the receiver to

detect arrivals of upgoing and downgoing seismic energy from the seismic source (Column 7, Line 65 to Column 9, Line 47). Kan discloses determining a velocity from the travel time and the selected depths (Column 8, Lines 1-57). Kan discloses inverting reflection seismic data (data reflected from structures below drillbit and received in the borehole receivers) to determine a velocity ahead of the drill bit while constraining the velocity between the surface and the drill bit to be consistent with the velocity determined from the travel time (Column 8, Line 40 to Column 9, line 3). Kan discloses that the VSP data is used to replace interval transit times from the surface seismic data with the velocity determined from the VSP checkshot survey to the depths of the borehole that the VSP data was taken. Replacing the velocity constrains it to being the velocity determined from the transit times of the VSP survey in the borehole.

Kan does not specifically disclose that the drill bit is left in the borehole when the VSP survey is taken. Kan discloses performing the VSP survey while drilling to obtain real time measurements of the formation surrounding the area being drilled, but does not specifically disclose that these measurements are made with the drill bit still in the wellbore. Eaton teaches performing VSP measurements in a wellbore being drilled and teaches using sensors mounted near the drill bit to perform such measurements (Columns 6-7) (Fig. 1). It would have been obvious to modify Kan to include sensors attached to the drill string as taught by Eaton so that the drill string does not need to be removed before making measurements (see Eaton, Column 7).

Kan does not disclose that the processor operated to detect arrivals is disposed in the borehole. Eaton teaches that processing means located in the borehole and in

communication with the receivers can perform processing on data collected from seismic sensors to determine arrivals of upgoing and downgoing energy (Column 6, Lines 17-68). It would have been obvious to modify Kan to include a processor in the borehole as taught by Eaton in order process signals downhole so that less information needs to be sent to the surface for processing in surface equipment.

Although Kan does not teach inverting the surface seismic data, Kan does disclose finding the velocities above the drill bit with the VSP, and then using this data in the process of finding interval velocities ahead of the bit by inversion methods for seismic data that has been reflected from structures ahead of the bit and received at receivers in the wellbore. Although Kan teaches that the receivers are in the wellbore and not on the surface, Leaney teaches that reflection data for structures in a downhole environment can be found with surface receivers instead of borehole receivers (Fig. 1) (Column 2, Line.60 to Column 3, Line 40; Column 4). The same methods of inverting the reflection data described in Kan would be applied whether the data is from a borehole or surface receiver, because both are reflected wave data. Leaney teaches that the surface reflection data can be calibrated by VSP data. Kan teaches a similar calibration of reflection data using VSP data, and teaches that the VSP data is used to calibrate the velocity for areas ahead of a drill bit obtained by inversion of the reflection data. Therefore, it would have been obvious to modify Kan to include using the surface seismic receivers to obtain the reflection data inverted to find interval velocities ahead of the bit. Receivers on the surface would not have some of the same noise as receivers

in the borehole because they would not pick up noise from the drillstring and other downhole equipment.

With regard to claim 19, Kan discloses transforming the velocity ahead of the drill bit into pore pressure of a region ahead of the drill bit (Column 6, Line 20 to Column 7, Line 21; Column 8, Lines 5-57).

With regard to claim 20, Kan discloses that the seismic wave is generated by a seismic source positioned near an opening of the borehole (Column 8, Lines 1-18).

With regard to claim 21, Kan discloses that determining the travel time of the seismic wave comprises detecting the seismic wave from at least one seismic receiver at location in the borehole (Column 8).

With regard to claim 22, Kan does not disclose that the seismic receiver is disposed in a downhole tool near the drill bit. Kan discloses using the receiver during drilling, but does not disclose the location of the receivers used. Eaton teaches a method of determining time-depth check-shots and also obtaining VSP data using a downhole tool 14 that is located near the drill bit 13 (Fig. 1) (abstract; Column 2). It would have been obvious to modify Kan to include using a tool located near the drill bit for the receiver in the borehole in order to be able to take data without requiring that the drillstring be removed or that further devices are placed into the borehole.

With regard to claim 23, Kan discloses that determining the travel time further comprises measuring the arrival time of the seismic wave detected at the seismic receiver and determining the travel time from the arrival time (Column 8, Lines 10-57).

With regard to claim 24, Kan does not disclose that measuring the arrival time comprises sending the seismic wave detected in the borehole to the surface and processing the detected seismic waves at the surface to determine arrival time. Kan does not disclose where the processing is performed. Eaton teaches that data obtained in receivers in a borehole can be sent to the surface for processing (Column 6, Lines 18-46). It would have been obvious to modify Kan to include sending the data to the surface to be processed as taught by Eaton in order to have a central processing unit at the surface that can perform all of the necessary data processing and also control the survey apparatus.

With regard to claim 25, Kan does not disclose that measuring the arrival time comprises processing the seismic wave detected in the borehole to determine the arrival time and sending the arrival time to the surface via telemetry. Kan does not disclose where the processing is performed. Eaton teaches that the data received in a borehole receiver can be processed in the receiver (Column 5, Lines 55-65; Column 6). It would have been obvious to modify Kan to include performing the processing in the borehole and sending the time to the surface via telemetry as taught by Eaton in order to reduce the data rate to a level commensurate with the link to the surface and to limit the amount of data that needs to be transmitted to the surface.

With regard to claim 26, Kan discloses a method of estimating velocity ahead of a drill bit disposed in a subsurface region (Column 8, Line 40 to Column 9, Line 10). Kan discloses generating seismic waves from a surface of the region while drilling. Kan discloses obtaining seismic wave data associated with the surface generated waves at

one or more locations in the borehole (Column 8, Lines 1-57). Kan discloses the obtaining seismic wave data including operating a receiver in a borehole at selected times (selected times during drilling) corresponding to predetermined times for generating seismic waves (Kan discloses that the source and receiver are operated together, and therefore the receiver is operated at the selected times of firing the source), and operating a processor in signal communication with the receiver to detect arrivals of upgoing and downgoing seismic energy from the generated seismic waves (Column 7, Line 65 to Column 9, Line 47). Kan discloses inverting the obtained seismic wave data with reflection seismic data (data reflected from structures below drillbit and received in the borehole receivers) obtained for the region to determine a velocity ahead of the drill bit (Column 8, Line 40 to Column 9, line 3). Kan discloses that the VSP data is used to replace interval transit times from the surface seismic data with the velocity determined from the VSP checkshot survey to the depths of the borehole that the VSP data was taken. Kan does not specifically disclose that the drill bit is left in the borehole when the VSP survey is taken.

Kan discloses performing the VSP survey while drilling to obtain real time measurements of the formation surrounding the area being drilled, but does not specifically disclose that these measurements are made with the drill bit still in the wellbore. Eaton teaches performing VSP measurements in a wellbore being drilled and teaches using sensors mounted near the drill bit to perform such measurements (Columns 6-7) (Fig. 1). It would have been obvious to modify Kan to include sensors

attached to the drill string as taught by Eaton so that the drill string does not need to be removed before making measurements (see Eaton, Column 7).

Kan does not disclose that the processor operated to detect arrivals is disposed in the borehole. Eaton teaches that processing means located in the borehole and in communication with the receivers can perform processing on data collected from seismic sensors to determine arrivals of upgoing and downgoing energy (Column 6, Lines 17-68). It would have been obvious to modify Kan to include a processor in the borehole as taught by Eaton in order process signals downhole so that less information needs to be sent to the surface for processing in surface equipment.

Although Kan does not teach inverting the surface seismic data, Kan does disclose finding the velocities above the drill bit with the VSP, and then using this data in the process of finding interval velocities ahead of the bit by inversion methods for seismic data that has been reflected from structures ahead of the bit and received at receivers in the wellbore. Although Kan teaches that the receivers are in the wellbore and not on the surface, Leaney teaches that reflection data for structures in a downhole environment can be found with surface receivers instead of borehole receivers (Fig. 1) (Column 2, Line.60 to Column 3, Line 40; Column 4). The same methods of inverting the reflection data described in Kan would be applied whether the data is from a borehole or surface receiver, because both are reflected wave data. Leaney teaches that the surface reflection data can be calibrated by VSP data. Kan teaches a similar calibration of reflection data using VSP data, and teaches that the VSP data is used to calibrate the velocity for areas ahead of a drill bit obtained by inversion of the reflection

data. Therefore, it would have been obvious to modify Kan to include using the surface seismic receivers to obtain the reflection data inverted to find interval velocities ahead of the bit. Receivers on the surface would not have some of the same noise as receivers in the borehole because they would not pick up noise from the drillstring and other downhole equipment.

With regard to claim 27, Kan discloses transforming the velocity ahead of the drill bit into pore pressure of a region ahead of the drill bit (Column 6, Line 20 to Column 7, Line 21; Column 8, Lines 5-57).

With regard to claim 28, Kan discloses that the surface seismic data is obtained for the subsurface region before the borehole is formed in the region (Column 6; Column 8, Lines 40-57).

With regard to claim 29, Kan does not disclose that the surface seismic data is obtained for the subsurface region after the borehole is formed in the region. Leaney teaches taking VSP surveys in a borehole and then using the surveys to create models that are used to process surface seismic data (abstract; Column 3, Line 55 to Column 4, Line 68). It would have been obvious to modify Kan to include taking VSP survey data, and then acquiring surface seismic data and processing the surface seismic data as taught by Leaney in order to have a model of the velocity created from the VSP data that can be used to process surface seismic data that is taken in a region.

With regard to claim 30, Kan does not disclose that the surface seismic data is obtained for the subsurface region during drilling of the borehole is formed in the region. Leaney shows acquiring VSP and surface seismic data at the same time (Fig. 1)

(abstract; Column 3, Line 55 to Column 4, Line 68). It would have been obvious to modify Kan to include taking both the data with the borehole receivers and the surface seismic data receivers at the same time as taught by Leaney in order to obtain a model from the VSP that is accurate for the formation at the time the surface seismic data are obtained.

With regard to claim 31, Kan discloses a method of estimating velocity ahead of a drill bit disposed in a subsurface region (abstract; Column 8, Line 40 to Column 9, Line 10). Kan discloses generating seismic waves from a surface region (Column 8, Line 40 to Column 9, Line 10). Kan discloses obtaining seismic wave data associated with the surface generated waves at one or more locations in the borehole (Column 8, Lines 1-57). Kan discloses the obtaining seismic wave data including operating a receiver in a borehole at selected times (selected times during drilling) corresponding to predetermined actuation times for generating seismic waves (Kan discloses that the source and receiver are operated together, and therefore the receiver is operated at the selected times of firing the source), and operating a processor in signal communication with the receiver to detect arrivals of upgoing and downgoing seismic energy from the generated seismic waves (Column 7, Line 65 to Column 9, Line 47). Kan discloses inverting the obtained seismic wave data with reflection seismic data (data reflected from structures below drillbit and received in the borehole receivers) obtained for the region to determine a velocity ahead of the drill bit (Column 8, Line 40 to Column 9, line 3). Kan discloses that the VSP data is used to replace interval transit times from the surface seismic data with the velocity determined from the VSP checkshot survey to the

depths of the borehole that the VSP data was taken. Kan does not specifically disclose that the drill bit is drilling when the waves are generated and received at the locations in the borehole.

Kan discloses performing the VSP survey while drilling to obtain real time measurements of the formation surrounding the area being drilled, but does not specifically disclose that these measurements are made during the drilling in the wellbore. Eaton teaches performing VSP measurements in a wellbore being drilled and teaches using sensors mounted near the drill bit to perform such measurements while drilling (abstract; Column 3; Columns 6-7) (Fig. 1). Eaton teaches that the receiver can be used while the drill bit is working, but states that it is preferable to use the receiver when the drilling is stopped to avoid the noise caused by drilling that would interfere with the data being taken. It would have been obvious to modify Kan to include sensors attached to the drill string as taught by Eaton so that the drill string does not need to be removed before making measurements (see Eaton, Column 7).

Kan does not disclose that the processor operated to detect arrivals is disposed in the borehole. Eaton teaches that processing means located in the borehole and in communication with the receivers can perform processing on data collected from seismic sensors to determine arrivals of upgoing and downgoing energy (Column 6, Lines 17-68). It would have been obvious to modify Kan to include a processor in the borehole as taught by Eaton in order process signals downhole so that less information needs to be sent to the surface for processing in surface equipment.

Although Kan does not teach inverting surface seismic data, Kan does disclose finding the velocities above the drill bit with the VSP, and then using this data in the process of finding interval velocities ahead of the bit by inversion methods for seismic data that has been reflected from structures ahead of the bit and received at receivers in the wellbore. Although Kan teaches that the receivers are in the wellbore and not on the surface, Leaney teaches that reflection data for structures in a downhole environment can be found with surface receivers instead of borehole receivers (Fig. 1) (Column 2, Line.60 to Column 3, Line 40; Column 4). The same methods of inverting the reflection data described in Kan would be applied whether the data is from a borehole or surface receiver, because both are reflected wave data. Leaney teaches that the surface reflection data can be calibrated by VSP data. Kan teaches a similar calibration of reflection data using VSP data, and teaches that the VSP data is used to calibrate the velocity for areas ahead of a drill bit obtained by inversion of the reflection data. Therefore, it would have been obvious to modify Kan to include using the surface seismic receivers to obtain the reflection data inverted to find interval velocities ahead of the bit. Receivers on the surface would not have some of the same noise as receivers in the borehole because they would not pick up noise from the drillstring and other downhole equipment.

With regard to claim 32, Kan discloses transforming the velocity ahead of the drill bit into pore pressure of a region ahead of the drill bit (Column 6, Line 20 to Column 7, Line 21; Column 8, Lines 5-57).

With regard to claim 33, Kan discloses that the step of generating seismic waves is performed according to a predetermined sequence (different depths) and the obtained seismic wave information is performed corresponding to the predetermined sequence (Column 8, Line 1 to Column 9, Line 10).

With regard to claim 34, Kan discloses determining seismic travel times from a position of the generating seismic waves to the one or more locations in the borehole (Column 7, Line 66 to Column 8, Line 57). Kan does not disclose that a processor in the borehole does in the determining. Kan does not disclose where the processing is performed. Eaton teaches that the data received in a borehole receiver can be processed in the receiver (Column 5, Lines 55-65; Column 6). It would have been obvious to modify Kan to include performing the processing in the borehole and sending the time to the surface via telemetry as taught by Eaton in order to reduce the data rate to a level commensurate with the link to the surface and to limit the amount of data that needs to be transmitted to the surface.

With regard to claim 35, Kan discloses determining seismic travel times from a position of the generating seismic waves to the one or more locations in the borehole (Column 7, Line 66 to Column 8, Line 57). Kan does not disclose where the determining is performed. Eaton teaches that data obtained in receivers in a borehole can be sent to the surface for processing (Column 6, Lines 18-46). It would have been obvious to modify Kan to include sending the data to the surface to be processed as taught by Eaton in order to have a central processing unit at the surface that can perform all of the necessary data processing and also control the survey apparatus.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to SCOTT A. HUGHES whose telephone number is (571)272-6983. The examiner can normally be reached on M-F 9:00am to 5:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jack Keith can be reached on (571) 272-6878. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/S. A. H./
Examiner, Art Unit 3663

/Jack W. Keith/
Supervisory Patent Examiner, Art Unit 3663